

New Very High Resolution Radar Studies of the Moon

Peter J. Mouginis-Mark and Bruce Campbell, Planetary Geosciences, Hawaii
Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822

As part of an effort to further understand the geologic utility of radar studies of the terrestrial planets, we are currently collaborating with investigators at NEROC Haystack Observatory, MIT and the Jet Propulsion Laboratory in the analysis of existing 3.8 and 70 cm radar images of the moon, and in the acquisition of new data for selected lunar targets. The intent is to obtain multi-polarization radar images at resolutions approaching 75 meters (3.8 cm wavelength) and 400 meters (70 cm wavelength) for the Apollo landing sites (thereby exploiting available ground-truth) or regions covered by the metric camera and geochemical experiments onboard the command modules of Apollos 15, 16 and 17. Similar studies were conducted by Moore and Zisk (1973) immediately following the Apollo Program, but at much lower spatial resolution and without the complete phase history of the radar echo being recorded.

As of Fall 1986, the acquisition of the new data is well underway. Three attempts have so far been made by S. Zisk at Haystack to obtain new images at 3.8 cm wavelength, and preliminary measurements of the leading edge of the moon and the Apollo 17 landing site show that geologically-useful images are likely to be produced by early 1987. 70 cm data have also been obtained by Thompson for Copernicus Crater. Currently, improvements still have to be made to the pointing of the radar antenna, but once the lunar ephemeris is better known and radar tracking has been improved it should be possible to obtain radar images measuring a few thousand square kilometers at the desired sub-kilometer resolution.

In the meantime, we are renewing studies of the 3.8 cm lunar maps produced by Zisk *et al.* (1974) and 70 cm data produced by Thompson (1986). These data were collected in both like- and cross-polarizations, and in the case of the 70 cm data, permit the phase records to be used to assess the scattering properties of the surface in a similar manner to the interpretation of terrestrial quad-polarized radar images (Thompson *et al.*, 1986; Zebker *et al.*, 1986). In particular, we are comparing the distribution of surface units on the moon that show a mismatch between the surface slope implied by like- and cross-polarized scattering data, based on the scattering models of Evans and Hagfors (1964), and Hagfors and Evans (1968). The unusual values of cross-to-like polarization observed for volcanic flows in western Mare Imbrium (Schaber *et al.*, 1975) have been observed in both of our existing data sets and, together with the Apollo landing sites and young craters Copernicus and Tycho, form the basis for targeting of new radar acquisitions for geologically-interesting areas on the moon over the coming months.

REFERENCES: Evans, J.V. and T. Hagfors (1964). On the interpretation of radar reflections from the moon. *Icarus*, vol. 3, p. 151-160. Hagfors, T. and J.V. Evans (1968). Radar studies of the moon. Chapter 5 in: *Radar Astronomy*, (J.V. Evans and T. Hagfors, Eds.), McGraw-Hill, N.Y. Moore, H.J. and S.H., Zisk (1973). Calibration of radar data from Apollo 17 and other mission results. *Apollo 17 Prelim. Sci. Rpt.*, NASA SP-330, p. 33-10 to 33-17. Schaber, G.G., T.W. Thompson and S.H. Zisk (1975). Lava flows in Mare Imbrium: An evaluation of anomalously low Earth-based radar reflectivity. *The Moon*, vol. 13, p. 395-423. Thompson, T.W. (1986). High resolution lunar radar map at 70-cm wavelength. Submitted to *Earth, Moon and Planets*. Thompson, T.W., H.A. Zebker and J.J. Van Zyl (1986). Lunar radar polarimetry. *Trans. Amer. Geophys. Union*, in press. Zebker, H.A., J.J. Van Zyl and D.N. Held (1986). Imaging radar polarimetry from wave synthesis. *J. Geophys. Res.*, in press. Zisk, S.H., G.H. Pettengill and G.W. Catuna (1974). High-resolution radar maps of the lunar surface at 3.8 cm wavelength. *The Moon*, vol. 10, p. 17-50.